

## CLAIMS

What is claimed is:

1. A distributed data frame structure for the transmission of data frames over  $N$  channels, each data frame being represented by  $L$  bytes, said distributed data frame structure comprising:

$N$  subframe structures, each corresponding to one of said channels;

a number of bytes from each data frame distributed among said subframe structures; and

a frame alignment signal comprising a pattern of bits, said frame alignment signal occurring every  $L$  bytes in each of said subframe structures.

2. A distributed data frame structure according to claim 1, wherein each data frame is formatted in accordance with ITU-T Recommendation G.709/Y.1331.

3. A distributed data frame structure according to claim 2, wherein  $N = 4$  and  $L = 16,320$ .

4. A distributed data frame structure according to claim 1, wherein said frame alignment signal occurs once in each data frame.

5. A distributed data frame structure according to claim 1, wherein said number of bytes are deinterleaved into said subframe structures.

6. A distributed data frame structure according to claim 1, wherein said frame alignment signal comprises a pattern of three A1 bytes followed by three A2 bytes.

7. A method of formatting a distributed data frame structure comprising:  
receiving a plurality of data frames, each comprising a plurality of bytes;  
establishing a plurality of subframe structures, each corresponding to one of a  
plurality of different transmission channels; and  
performing a rotating deinterleaving procedure on said plurality of data  
frames.

8. A method according to claim 7, wherein said rotating deinterleaving  
procedure distributes bytes from each of said plurality of data frames among each of  
said plurality of subframe structures.

9. A method according to claim 7, wherein:  
each of said plurality of data frames includes a frame alignment signal  
comprising a pattern of bits; and  
said rotating deinterleaving procedure distributes said frame alignment signal  
periodically within each of said plurality of subframe structures.

10. A method according to claim 9, wherein:  
each of said plurality of data frames is represented by  $L$  bytes; and  
said rotating deinterleaving procedure distributes said frame alignment signal  
such that it occurs every  $L$  bytes in each of said subframe structures.

11. A method according to claim 9, wherein said rotating deinterleaving  
procedure comprises:

assigning a first instance of said frame alignment signal to a reference location  
in a first one of said plurality of subframe structures to identify a reference position in  
a first one of said data frames; and

assigning a second instance of said frame alignment signal to said reference  
location in a second one of said plurality of subframe structures to identify said  
reference position in a second one of said data frames.

12. A method according to claim 7, wherein each of said plurality of data frames is formatted in accordance with ITU-T Recommendation G.709/Y.1331.

13. A data communication apparatus comprising:  
an input node configured to obtain a plurality of data frames, each comprising a plurality of bytes; and  
a rotating deinterleaver configured to reformat said data frames into a plurality of subframe structures, each corresponding to one of a plurality of different transmission channels.

14. A data communication apparatus according to claim 13, further comprising a plurality of serializers coupled to said rotating deinterleaver, each of said plurality of serializers being configured to generate serial data representing one of said plurality of subframe structures.

15. A data communication apparatus according to claim 13, further comprising a framer configured to align said plurality of data frames.

16. A data communication method comprising:  
receiving a plurality of data frames at a first data rate, each of said plurality of data frames comprising a plurality of bytes;  
performing a rotating deinterleaving procedure to distribute data from said plurality of data frames into a plurality of subframe structures; and  
transmitting each of said plurality of subframe structures over one of a plurality of channels, each of said plurality of subframe structures being transmitted at a second data rate less than said first data rate.

17. A method according to claim 16, wherein each data frame is formatted in accordance with ITU-T Recommendation G.709/Y.1331.

18. A method according to claim 16, wherein:

each of said plurality of data frames includes a frame alignment signal comprising a pattern of bits; and

    said rotating deinterleaving procedure distributes said frame alignment signal periodically within each of said plurality of subframe structures.

19. A method according to claim 16, further comprising:

receiving said plurality of subframe structures on said plurality of channels;

framing each of said plurality of subframe structures to obtain aligned subframe structures; and

    performing a rotating interleaving procedure on said aligned subframe structures to recreate said plurality of data frames.

20. A method according to claim 19, further comprising de-skewing said aligned subframe structures.

21. A method according to claim 19, wherein said rotating interleaving procedure reverses the effect of said rotating deinterleaving procedure.

22. A method according to claim 19, further comprising transmitting recreated data frames over a single channel at said first data rate.

23. A data communication apparatus comprising:

    at least one input node configured to obtain a plurality of subframe structures from a plurality of channels, each of said plurality of subframe structures comprising a plurality of bytes; and

    a rotating interleaver configured to distribute data from said plurality of subframe structures into a data frame.

24. An apparatus according to claim 23, further comprising a plurality of framers configured to frame said plurality of subframe structures to obtain aligned subframe structures.

25. An apparatus according to claim 24, further comprising a de-skewing circuit configured to de-skew said aligned subframe structures, wherein said rotating interleaver is coupled to receive de-skewed data from said de-skewing circuit.

26. A data communication method comprising:

receiving, at a first data rate, a plurality of subframe structures from a plurality of channels, each of said plurality of subframe structures comprising a plurality of bytes; and

performing a rotating interleaving procedure to distribute data from said plurality of subframe structures into a data frame formatted for transmission at a second data rate higher than said first data rate.

27. A method according to claim 26, wherein said data frame is formatted in accordance with ITU-T Recommendation G.709/Y.1331.

28. A method according to claim 26, further comprising framing each of said plurality of subframe structures to obtain aligned subframe structures.

29. A method according to claim 28, further comprising de-skewing said aligned subframe structures.

30. A method according to claim 26, further comprising transmitting recreated data frames over a single channel at said second data rate.